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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/808,168	03/24/2004	Haowen Bu	TI 37782	4831
23494	7590	01/05/2006	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED			AHMADI, MOHSEN	
P O BOX 655474, M/S 3999			ART UNIT	
DALLAS, TX 75265			PAPER NUMBER	
			2812	

DATE MAILED: 01/05/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

H.A

Office Action Summary	Application No. 10/808,168	Applicant(s) BU ET AL.	
	Examiner Mohsen Ahmadi	Art Unit 2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) 1-10 and 14-23 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 14-23 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 03/24/2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

The Applicants' response of 12/27/2005 has been considered and entered in the record. The Applicants' arguments have been considered, but they are not persuasive for the reasons as disclosed below.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 14 and 15 are rejected under 35 U.S.C. 102(b) as being anticipated by Yu (US Pat. 6,326,291) for the reasons as discussed in the previous Office action.

The present claims generally require a method for manufacturing a semiconductor device, comprising: forming a protective layer over a polysilicon gate electrode located over a substrate to provide a capped polysilicon gate electrode; forming source/drain regions in substrate proximate capped polysilicon gate electrode; removing protective layer using an etchant; siliciding polysilicon gate electrode to form a silicided gate electrode; and siliciding source/drain regions. Claims 14 and 15 further require the formation of an interconnection.

Regarding claim 1, Figure 2 of Yu discloses a semiconductor substrate 208 comprising a polysilicon gate electrode 212, and a capping layer 216 which is

comprised of a hardmask material such as siliconoxynitride (SiON) which is disposed over the top of the polysilicon gate structure 212. Yu discloses a method of forming source 204 and drain 202 regions in the substrate proximate the capped polysilicon gate electrode. Yu discloses a method of removing protective layer using an etchant (See col 5, lines 43-44). Yu discloses a method of siliciding the polysilicon gate (silicidation metal) to form a silicided gate (See col 5, lines 60-63). Yu also discloses a method of siliciding source and drain regions that comprise of a metal silicide such as nickel silicide (NiSi_2) (See col 5, lines 16-18).

Regarding claim 14, Figure 2 of Yu discloses a method for forming semiconductor devices 200 over a substrate 208 including; a polysilicon gate electrode 212 and a capping layer 216 comprised of a hardmask material such as siliconoxynitride (SiON) which is disposed over the top of the polysilicon gate structure 212. Yu discloses a method of forming source 204 and drain 202 regions in substrate proximate capped polysilicon gate electrode. Yu discloses a method of removing protective layer using an etchant (See col 5, lines 43-44). Yu discloses a method of siliciding the polysilicon gate (silicidation metal) to form a silicided gate (See col 5, lines 60-63). Yu discloses a method of siliciding source and drain regions that comprised of a metal silicide such as nickel silicide (NiSi_2) (See col 5, lines 16-18). Figure 10 and 11 of Yu also discloses formation of interconnect to the gate silicide. A second dielectric layer 250 is deposited over the gate silicide 240 and over the first dielectric layer 230. A gate interconnect 252 is formed on the second dielectric layer 250, and the gate interconnect 252 is conductively coupled to the gate silicide 240 with a gate via 254. In

addition, a drain interconnect 256 is formed on the second dielectric layer 250, and the drain interconnect 256 is conductively coupled to the drain silicide 220 with a drain via 258. Similarly, a source interconnect 260 is formed on the second dielectric layer 250, and the source interconnect 260 is conductively coupled to the source silicided 222 with a source via 262 (See col 6 and 7, lines 61-67 and 1-9).

Regarding claim 2 and 15, Figure 3 of Yu discloses a method of forming a silicide blocking layer over source and drain regions prior to siliciding polysilicon gate electrode. This dielectric layer 230 is comprised of a dielectric material such as silicon dioxide (SiO_2) (See col, 5 lines 25-30).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3, 4, 5, 16, 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu (US Pat. 6,326,291) in view of Chang (US Pat. 6,794,313) for the reasons as discussed in the previous Office action.

Yu is relied upon as discussed above.

Regarding claim 3, 4, 5, 16, 17 and 18 Yu discloses all of the claimed features as stated above except for growing a silicide blocking layer using a dry oxidation process

and low temperature radical oxidation or plasma oxidation process, and the thickness of blocking layers.

Regarding claims 3 and 16 Chang discloses a silicon dioxide layer which is formed over the surface of substrate, where the silicon dioxide, thermally grown in an oxygen-steam ambient at a temperature between 800 and 1,000 degrees C using a dry oxidation process (See col, 3 lines 48-53).

Regarding claims 4 and 17 Chang discloses a methods of oxidation that can be used for the creation of silicon dioxide in a dry oxygen and anhydrous hydrogen chloride in an atmospheric or low pressure environment or in a low temperature, high pressure environment and the like (See col, 3 lines 48-64).

Regarding claims 5 and 18 Chang discloses the thickness ranging for silicon dioxide are about 30 to 300 Angstrom (See col, 3 lines 53-54).

As Yu calls for the formation of silicon dioxide, it would have been obvious to one of ordinary skill in the art, at the time of invention, to use the method as disclosed by Chang for forming the silicon dioxide layer. The selection of the reactor parameters for forming a silicon dioxide layer would have been *prima facie* obvious in view of the teaching of Chang.

Claims 6 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu (US Pat. 6,326,291) in view of Chan et al. (US Pat. 2005/0179098) for the reasons as discussed in the previous Office action.

Yu is relied upon as discussed above. Yu discloses the use of a hardmask layer such as siliconoxynitride as the protective layer.

However Yu does not disclose silicon nitride as the protective layer.

Regarding claims 6 and 19 Chan et al. discloses a hard mask layer such as silicon nitride can be selectively etched with respect to the polysilicon gate, and is deposited by a CVD process to protect the top surface of the polysilicon gate (See page, 2 paragraph [0024]).

It would have been obvious to one of ordinary skill in the art, at the time of invention, to use a silicon nitride hardmask layer as disclosed by Chan et al. to protect the polysilicon gate as disclosed by Yu for their known benefit of protection of the underneath layer. Yu broadly calls for silicon oxynitride and other hardmask materials, and Chan discloses that silicon nitride is a known hardmask layer. Therefore, a *prima facie* case of obviousness is established.

Claims 7, 8, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu (US Pat. 6,326,291) in view of Chan et al. (US Pat. 2005/0179098) further in view of Moore et al. (US Pat. 20010034129) for the reasons as discussed in the previous Office action.

Yu and Chan et al. are relied upon as discussed above and discloses all of the claimed features as stated above except for the sidewall spacer including nitride, the different nitride composition of the spacer and the protective layer, and the nitride carbon content of 5-10%.

Furthermore, Chan et al. teaches nitride is a preferred insulating material for a gate sidewall and as Yu teaches any insulating material may be used. Regarding claims 7 and 20 Chan et al. discloses the spacers comprise an insulator material, such

as oxide or nitride. Preferably, the spacers comprise silicon nitride are formed adjacent capped polysilicon gate electrode (See page, 2 paragraph [0028]).

It would have been obvious to one of ordinary skill in the art, at the time of invention, to use the method of Chan et al. to form the spacer containing nitride because as Chan et al. teaches nitride is a preferred insulating material for a gate sidewall and as Yu teaches any insulating material may be used. Furthermore it has been held that the selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in Sinclair & Carroll Co. v. interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945). See also In re Leshin, 227 F.2d 197, 125 USPQ 416 (CCPA 1960).

Regarding claim 8 and 21, Yu discloses all of the claimed features as stated above except for the nitride layer has from about 5% to about 10% carbon content.

Regarding claims 8 and 21 Moore et al. discloses an etch stop layer for example silicon nitride to form the substrate where silicon nitride layer having from 2% to about 20% carbon incorporated (by weight) (See page, 4 paragraph [0045]).

It would have been obvious to one of ordinary skill in the art, at the time of invention, to use nitride layer that has about 5% to about 10% carbon content as disclosed by Moore et al. to form the sidewall spacer containing nitride as disclosed by Yu and Chan et al. for their known benefit selectivity when etching for integration or interconnects (See page, 4 paragraph [0046]). It also has been held that the selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in Sinclair & Carroll Co. v. interchemical Corp., 325 U.S.

Art Unit: 2812

327,65 USPQ 297 (1945). See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). Moreover, the formation of the spacer using the nitride of Moore et al. would result in a different chemical composition than the nitride which is used as the blocking layer as disclosed by Yu and Chan et al. as Chan et al. does not specify the carbon content of its nitride layer.

Claims 9 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu is relied upon as discussed above. (US Pat. 6,326,291) for the reasons as discussed in the previous office action.

Yu discloses in their invention the method of siliciding the source and drain regions, but do not discloses the method wherein the silicide extends under a portion of gate sidewall spacers.

However Yu discloses in the prior art the method where silicided source and drain regions 114 and 116 are extended under a portion of gate sidewall spacers 113 located adjacent to silicided gate electrode 112. See figure 1.

It would have been obvious to one of ordinary skill in the art, at the time of invention, to form extending under a portion of gate sidewall spacers located adjacent silicided gate electrode because it is disclosed in the Yu et al reference as an unpreferred embodiment. Unpreferred embodiments must be considered in determining obviousness. See *In re Burckel*, 201 USPQ 67 (1979). Moreover, a reference is not limited to preferred embodiments. See *In re Boe*, 148 USPQ 507 (CCPA 1966). The use of a structure disclosed in the prior art would be within the level of one of ordinary skill in the art.

Claims 10 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu (US Pat. 6,326,291) in view of Chan et al. (US Pat. 2005/0179098) for the reasons as discussed in the previous Office action.

Yu is relied upon as discussed above.

Regarding claim 10 and 23 Yu discloses all of the claimed features as stated above except for the thickness of protective layer.

Regarding claims 10 and 23 Chan et al. discloses a method where the protective layer, silicon nitride has a thickness ranging from about 100 angstroms to about 1,000 angstroms (See page, 2 paragraph [0024]).

It would have been obvious to one of ordinary skill in the art, at the time of invention, to use the thickness ranges as disclosed by Chan et al. in the protective layer as disclosed by Yu for their known benefit in protecting silicide layers. The examiner notes both references are drawn to analogous art, the protection of silicide layers using hard mask nitride and therefore a *prima facie* cases of obviousness is established.

Response to Applicant's Arguments

With respect to rejection of claims 1, 2, 14 and 15 under 35 USC § 102 as being anticipated by Yu, applicants argue that independent claims 1 and 14 include the element, among others, of siliciding source/drain regions after siliciding the polysilicon gate electrode, Yu fails to disclose this element. Applicant also argue that claims 2 and 15 are dependent upon claims 1 and 14, Yu also cannot be an anticipating for claims 2 and 15. The examiner maintains that the claim language 1, does not

require silicided source/drain 220/222, to be before or after silicided polysilicon gate electrode 240.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., silicided source/drain regions 220, 222 are formed after the silicided polysilicon gate electrode 240) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

With respect to rejection of claims 3, 4, 5, 16, 17 and 18 under 35 USC § 103 as being unpatentable over Yu in view of Chang, applicants argue that the silicided blocking layer may be grown using a dry oxidation process, low temperature radical oxidation or plasma oxidation process, as well as thickness of the blocking layers, is very different from a teaching or suggestion of siliciding source/drain regions after siliciding the polysilicon gate electrode. Applicants argue that the Chang reference does not cure the deficiencies of Yu. The examiner maintains that the claim language 1, does not require silicided source/drain 220/222, to be before or after silicided polysilicon gate electrode 240.

With respect to rejection of claims 6 and 19 under 35 USC § 103 as being unpatentable over Yu in view of Chan, applicants argue that the hardmask layer comprising siliconoxynitride may be used as a protective layer, is very different from a teaching or suggestion of siliciding source/drain regions after siliciding the polysilicon gate electrode. Applicants argue that the Chan reference does not cure the deficiencies

of Yu. The examiner maintains that the claim language 1, does not require silicided source/drain 220/222, to be before or after silicided polysilicon gate electrode 240.

With respect to rejection of claims 7, 8, 20 and 21 under 35 USC § 103 as being unpatentable over Yu in view of Chan et al. further in view of Moore et al., Applicants argue that the sidewall spacer may comprise a nitride, the different nitride composition of the spacer and the protective layer, and the nitride carbon content of 5-10%, is very different from a teaching or suggestion of siliciding source/drain regions after siliciding the polysilicon gate electrode. Applicants argue that the moore et al. reference does not cure the deficiencies of Yu. The examiner maintains that the claim language 1, does not require silicided source/drain 220/222, to be before or after silicided polysilicon gate electrode 240.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., silicided source/drain regions 220, 222 are formed after the silicided polysilicon gate electrode 240) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

With respect to rejection of claims 9 and 22 under 35 USC § 103 over Yu, Applicants argue that, as previously established, Yu fails to teach or suggest the element, among others, of siliciding source/drain regions after siliciding polysilicon gate electrode as required by claims 1 and 14. The examiner maintains that the claim

language 1, does not require silicided source/drain 220/222, to be before or after silicided polysilicon gate electrode 240.

With respect to rejection of claims 10 and 23 under 35 USC § 103 as being unpatentable over Yu in view of Chan, applicants argue that, as previously established, Yu fails to teach or suggest the element, among others, of siliciding source/drain regions after siliciding polysilicon gate electrode as required by claims 1 and 14. Applicants argue that the Chan reference does not cure the deficiencies of Yu. The examiner maintains that the claim language 1, does not require silicided source/drain 220/222, to be before or after silicided polysilicon gate electrode 240.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., silicided source/drain regions 220, 222 are formed after the silicided polysilicon gate electrode 240) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mohsen Ahmadi whose telephone number is 1-571-272-5062. The examiner can normally be reached on Mon-Thur 8:00am-6:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on 1-571-272-1873. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MA *MA*
12/27/2005


MICHAEL LEBENTRITT
SUPERVISORY PATENT EXAMINER